

REMARKS/ARGUMENTS

Claims 71-90 are pending. No claims have been amended or added. No new matter has been added.

In summary of the present Office Action, the Examiner has:

I. Rejected claims 71-73, 76-84, 86-87, and 89-90 under 35 U.S.C. §103(a) as unpatentable over Schueller, U.S. Pat. No. 5,866,949, in view of Lau, "Chip on Board Technologies for Multichip Modules," and Futakuchi, U.S. Pat. No. 6,308,938;

II. Rejected claims 74 and 85 under 35 U.S.C. §103(a) as unpatentable over Schueller in view of Lau and Futakuchi, and further in view of Zenner, U.S. Pat. No. 5,866,949; and

III. Rejected claims 75 and 88 under 35 U.S.C. §103(a) as unpatentable over Schueller in view of Lau and Futakuchi, and further in view of Freyman, U.S. Pat. No. 5,985,695.

The Applicants respectfully traverse these rejections.

I. Rejection of claims 71-82

Claim 71 recites, in part:

a mold cap which encapsulates the silicon die and the transition medium, wherein the transition medium and the mold cap expand and contract at approximately the same rate in response to temperature changes so as to reduce thermal stress on the silicon die during thermal cycling.

The Applicants respectfully submit that there is no suggestion or motivation to combine or modify the references to meet at least the above-recited claim limitation of "the first thickness of the silicon die is less than the second thickness."

MPEP 2143.01 states that "obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is

some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art." (MPEP 2100-130).

In the present case, the Examiner concedes that Schueller fails to teach the mold cap and the transition medium expand and contract at approximately the same rate in response to temperature changes so as to reduce thermal stress on the silicon die during thermal cycling.

Additionally, neither Lau or Futakuchi disclose or suggest that the mold cap and the transition medium should expand and contract at approximately the same rate in response to temperature changes.

Lau states that it is important "for encapsulants to have a low thermal coefficient of expansion (TCE). This is necessary in order to minimize thermal stresses due to the TCE mismatch between the encapsulant and other circuit materials including the substrate (PCB or ceramic), the silicon IC chips and their solder or wire bond interconnections." (Lau, p.475). Thus, Lau teaches that it is important to minimize the thermal coefficient of expansion to reduce thermal stress.

In contrast, the Applicants disclose that it is important for "the transition medium and the mold cap expand and contract at approximately the same rate in response to temperature changes." According to the Applicants, it is the difference in materials' coefficients of thermal expansion, rather than their absolute magnitudes as taught by Lau, that cause thermal stress. By selecting materials so that "the transition medium and the mold cap expand and contract at approximately the same rate in response to temperature changes," as recited by claim 71, the result is "a more uniform contraction and expansion of the die packaging 12." (Specification, p. 9, lines 29-31).

Futakuchi discloses that a reinforcement base (Fig. 1, reference number 4), is placed on top of the sealing resin layer (Fig. 1, reference number 5). In Futakuchi, it is the sealing layer 5, not the reinforcement base 4, that encloses the chip or die (Fig. 1, reference

number 1). Thus, the reinforcement base 4 of Futakuchi is not a mold cap or other encapsulating material as recited by claim 71.

Futakuchi discloses that the coefficient of thermal expansion of the reinforcement base and the carrier base (Fig. 1, reference number 3) have the same coefficient of thermal expansion. (Col. 5, lines 42-45). However, Futakuchi does not disclose any specific value of the coefficient of thermal expansion of the sealing resin layer 5.

The Examiner states that Futakuchi suggests using glass fiber-reinforced epoxy having a coefficient of thermal expansion of 16×10^{-6} for the sealing resin layer 5. The Applicants respectfully disagree and submit that Futakuchi discourages using this material for sealing resin layer 5. Futakuchi discloses that "the sealing resin layer is added by transfer molding or injection molding." (Col. 5, lines 55-57). The Applicants believe that glass fiber-reinforced epoxy cannot be molded or manufactured using transfer molding or injection molding. Therefore, Futakuchi discourages using glass fiber-reinforced epoxy for the sealing resin layer 5.

Because Schueller, Lau, and Futakuchi do not suggest that the mold cap and any other materials should have the same coefficient of thermal expansion, the Applicants respectfully submit that there is no suggestion or motivation to combine or modify the references to meet at least the above-recited claim limitation of "the transition medium and the mold cap expand and contract at approximately the same rate in response to temperature changes." Therefore Applicants respectfully submit that claim 71 and its dependent claims are patentable over the cited references.

With regard to claim 76, the Examiner states that "the determination of parameters such as . . . the relative position and an arrangement of various components within the package, etc. in chip packaging and encapsulation technology is a subject of routine experimentation and optimization." The Examiner has not cited any reference supporting this assertion.

The Applicants respectfully traverse this assertion that such parameters are "subject of routine experimentation and optimization" and respectfully request that the Examiner either provide documentary evidence to support this assertion against the above-cited claim element or withdraw this rejection. (See MPEP 2144.03).

With regard to claim 77, the Examiner states that this claim is a product by process claim. The Applicants respectfully disagree. A product by process claim "is a product claim that defines the claimed product in terms of the process by which it is made." (MPEP 2173.05(p)).

Claim 77 is directed to an apparatus (an integrated circuit package). Claim 77 does not include any active steps describing how to make an integrated circuit package. Rather, the cited limitation of "such that the die remains relatively motionless within the integrated circuit package during thermal cycling" is a functional limitation. "A functional limitation is an attempt to define something by what it does, rather than by what it is." (MPEP 2173.05(g)).

A functional limitation must be evaluated and considered, just like any other limitation of the claim, for what it fairly conveys to a person of ordinary skill in the pertinent art in the context in which it is used. (MPEP 2173.05(g)). The Examiner has not cited any portion of Schueller, Futakuchi, or Lau that discloses or suggests this functional limitation. Therefore, the Applicants respectfully request that this rejection of claim 77 be withdrawn.

II. Rejection of claims 83-90

Claim 83 recites, in part:

a mold cap which encapsulates the silicon die and the transition medium, wherein the mold cap and transition medium expand and contract in response to temperature changes such that the die remains relatively motionless within the integrated circuit package during thermal cycling.

The Applicants respectfully submit that none of the cited references disclose or suggest this element of claim 83.

Like claim 77 discussed above, the Applicants respectfully submit that claim 83 is not a product by process claim, but an apparatus claim with a functional limitation. A functional limitation must be evaluated and considered, just like any other limitation of the claim, for what it fairly conveys to a person of ordinary skill in the pertinent art in the context in which it is used. (MPEP 2173.05(g)). The Examiner has not cited any portion of Schueller, Futakuchi, or Lau that discloses or suggests this functional limitation. Therefore, the Applicants respectfully submit that claim 83 and its dependent claims are patentable and request that this rejection be withdrawn.

III. Rejection of claims 74 and 85

Claims 74 and 85 are patentable over the cited references by virtue of their dependence on patentable independent claims. Additionally, the Applicants respectfully submit that the cited references do not disclose at least the above-recited claim limitations

Claim 74 recites, in part:

wherein the transition medium has a second thickness, and the first thickness of the silicon die is less than the second thickness of the transition medium.

Claim 85 recites a similar limitation.

The Applicants respectfully submit that none of the cited references disclose or suggest an integrated circuit package in which the thickness of the silicon die is less than the thickness of the transition medium.

In the Office Action of March 15, 2005, the Examiner concedes that Schueller fails to teach that "the first thickness of the silicon die being less than the second thickness" of the transition medium. (Office Action of March 15, 2005, p.4).

Neither Lau or Futakuchi disclose or suggest a transition medium between the silicon die and the substrate. Thus, Lau and Futakuchi cannot disclose or suggest that the limitation that "the transition medium has a second thickness," as recited by claims 74 and 85.

The Examiner states that "Zenner et al. teach using a high density/thin package having a die thickness/first thickness where the die has been thinned/lapped to about less than 100 microns or preferably less than 20 microns and a package thickness of about 275 microns." However, the package thickness of Zenner refers to the entire device package, not a transition medium. Zenner states that "the present invention is a circuit package 10." (Col. 3, lines 46-47). As shown in figure 1 of Zenner, the circuit package 10 is the entire device package that includes one or more dies.

In contrast, the transition medium recited by claim 74 is "disposed between the silicon die and the first side of the substrate." (Claim 71). It is impossible to construe the circuit package of Zenner as a transition medium between a die and a substrate, because the circuit package of Zenner includes the die itself.

In summary, to the extent that prior art such as Schueller disclose a purported transition medium, they all clearly discuss a silicon die having a thickness much greater than the associated purported transition medium. Thus, the Applicants respectfully submit that the cited references fail to disclose the claim limitation of "the first thickness of the silicon die is less than the second thickness of the transition medium." The Applicants respectfully submit that claims 74 and 85 are patentable.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are patentable and in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

The Applicants invite the Examiner to contact the undersigned if he believes a telephone conference would expedite the prosecution of this application.

Respectfully submitted,



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